CubeSat to Validate On-Board Processing Algorithm in Space

As satellite measurements of Earth become increasingly complex, many future missions will generate volumes of data too large to be transmitted to the ground by current methods. The Multi-angle Spectropolarimetric Imager (MSPI) instrument, for example (a candidate for the NASA Aerosol - Cloud - Ecosystems (ACE) mission) could potentially produce 95 MB per second from each of its nine cameras. One solution to the downlink problem is to conduct the first stage of data processing onboard the satellite.

An ESTO-funded project led by Paula Pingree at the Jet Propulsion Laboratory has developed a data processing algorithm to do just that. Designed specifically for MSPI, and paired with a commercial radiation-hardened Field Programmable Gate Array (FPGA) from Xilinx, the algorithm could effectively reduce downlink requirements by two orders of magnitude.

But how to test it in space? Enter M-Cubed, the Michigan Multipurpose Minisat. M-Cubed is a CubeSat: a 10 × 10 × 10 cm mini-satellite designed to be launched as an auxiliary payload of a larger satellite. Built with ESTO funding by students at the University of Michigan's Student Space Systems Fabrication Lab, M-Cubed contains the FPGA with the MSPI algorithm and a small camera – a stand-in for MSPI that will take mid-resolution color images of Earth.

M-Cubed was successfully launched on October 28, 2011, aboard the Delta II rocket that ferried NASA's NPOESS Preparatory Project (NPP) mission into space. In all, the NPP mission contained three Poly Picosatellite Orbital Deployers (P-PODs), each capable of deploying up to three CubeSats.

During its multi-month flight, M-Cubed will validate the MSPI onboard processing system and pave the way for future high-data-rate Earth science missions.

For more information on emerging technologies for Earth science, visit the ESTO website at: http://esto.nasa.gov
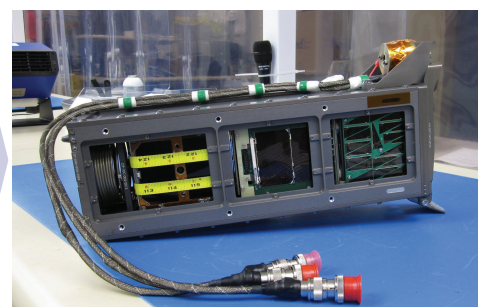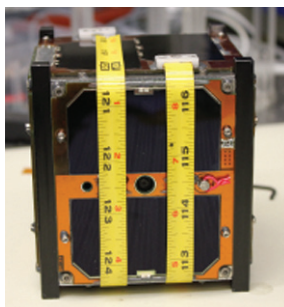
Top: the M-Cubed CubeSat, complete with deployable measuring tape antennae, and the M-Cubed packaged into a P-POD with two other CubeSats.
(Images Credit: Michigan Exploration Laboratory)

Bottom: the NPP satellite is fitted into the Delta II nose cone. Note the P-PODs highlighted in the lower right of the image.
(Image Credit: M.P. Mackley)